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was at one time, about twenty-five to fifty years ago, the principal source of supply for the larger markets of the country, and especially for New-York City; and the trade between these two places was of great importance. The Cape-Cod grounds are now, however, so nearly depleted that the annual catch is of very slight value. Other important areas have shown indications of a similar decrease; and the market supplies have been increased from year to year only through a great extension seaward of the fishing-grounds, and the much greater number of traps used. A suggestive indication of the decrease in abundance of lobsters is furnished by the marked decrease in the average size of those now taken to supply the trade.

The fact was noted that the lobster is not a truly migratory species, but simply moves into slightly deeper water on the approach of cold weather, to return again to the same shallow areas as the spring advances. Continued over-fishing in any one region will therefore tend to reduce the stock of lobsters in that region, without the probability of its being rapidly replenished by migrations from a neighboring region; and the greater or less depletion of many areas may be explained in that way.

The solution of the problem as to how the fishery may be protected in the interests of the fishermen and the trade must be reserved for future investigations; but existing laws do not appear to give the desired benefits.

On Tuesday evening the association met in the hall of the National museum, to listen to an address by Hon. Theodore Lyman of Massachusetts, who reviewed the work of the U. S. fish-commission and of the state commissions in an able manner.

Hon. Theodore Lyman was elected president of the society for the ensuing year; and during the return trip from the river-excursion on the steamer Fishhawk, the name of the association was, after considerable discussion by the members present, changed to the 'American fisheries society.' A conference of all of the state fish-commissioners present at the meeting, with the U. S. commissioner of fish and fisheries, Professor Baird, was held on the 15th.

MEETING OF MECHANICAL ENGINEERS AT PITTSBURGH.

THE meeting of the American society of mechanical engineers at Pittsburgh, May 20-24, was in many respects one of the most interesting that has been held. The attendance was as good as usual, say twenty-five per cent of the membership, and the quality of the papers above the average. The arrangements for the social comfort and enjoyment of the guests were not, however, so complete as at the last spring meeting. It was a mistake, that the announcement of a *conversazione* and social re-union was not carried out, and an opportunity given, early in the meeting, for the formation and renewal of acquaintances. The excursions so generously provided were of great interest; but we venture the assertion that the mass of the visitors gained but little accurate information. By providing

for such an occasion an appropriate manual or guide, or possibly a larger reception committee, the advantage to the guests can easily be quadrupled. It might even be better, as was done at the last meeting, to devote the whole day to a well-planned visit to a single establishment.

The society met in joint session with the Engineers' society of western Pennsylvania, whose president, Mr. Miller, welcomed the visitors, and invited their president, Prof. John E. Sweet (formerly of Cornell university), to the chair. The evening of May 20 was devoted to the report of Messrs. Roberts, Phillips, Hunt, McDowell, and Jarboe, — a committee appointed, at the January meeting of the local society, to investigate the whole subject of natural gas. There are also a city, and an underwriters' committee on the same subject.

Though Pittsburgh is within reach of three or four prolific localities, and gas has been used for many years, it is but recently that any organized effort has been made to use it on a large scale. Already there are a hundred and fifty companies chartered in the state, representing over two million dollars; and gas is brought from eight to twenty-five miles for use in the city. Five-inch mains are being followed by eight-inch, new wells are being bored, and the time when Pittsburgh shall become a smokeless city may not be far distant. Though the gas is used under a pressure of a few ounces, the pressures at the wells run from fifty to a hundred and twenty-five pounds: this is due to the friction in the mains, five pounds being allowed for each mile. If the flow be shut off the pressure runs up much higher, and great difficulty has been experienced in making tight joints; cast-iron is too porous, and ordinary pipe-threads do not fit well enough. A number of new coupling-devices were exhibited, in some of which a lead packing was used. No allowance for expansion need be made, as the gas maintains an even temperature of about 45° F. When gas is allowed to burn freely at the mouth of a well, the cold produced by the expansion is such that ice has been projected through the flames.

The gas is used in all kinds of furnaces for making steam, iron, glass, etc.; and electric-light carbons, and the finest lampblack for printing-inks, are made from it: but it is used with suicidal wastefulness, which causes anxiety, as many wells give out in less than five years. The report looks to its economic and safe control. For household use it might otherwise be dangerous; and such use has commenced, though no practicable method of deodorizing it has been found. Being composed largely (ninety-six per cent) of marsh-gas, its value as a heating-agent is high, and its density is about half that of air. One pound (23.5 cubic feet) of gas has a theoretical evaporating-power of twenty-four pounds of water, twenty pounds having been actually evaporated. The best method of burning it is not generally known: experiments with injector-burners show that they do not suck in sufficient air for complete combustion, and the best results have been from numerous jets in contact with the whole heating-surface of the boiler. The value of the gas, as compared by evaporation tests with coal at \$1.40

per ton, is only eight cents per thousand feet (which suggests that even our ordinary gas companies make profits), but its use is immensely more convenient; no stacks are needed, and the furnace reduces to a simple non-conducting chamber. The gas has just been turned on to the city water-works; and on the afternoon of May 22 a well was reported on the property of Mr. Westinghouse, near Pittsburgh. On the first day's excursion numerous furnaces were seen running with gas blown in through rough, one-eighth inch nozzles; and two or three lines of five-inch pipe lay on the surface of the railway embankment.

Mr. J. W. Cloud, engineer of tests for the Pennsylvania railroad, read a paper on helical springs. It was here claimed that round steel is better than square, flat, or other shaped; and an investigation, mathematical and experimental, was described, on the usual and mainly correct hypothesis that the strains are entirely torsional. Bars of oil-tempered and untempered steel, five feet long by three-fourths to one and five-sixteenths inches diameter, had been tested, and the constants of elasticity, etc., obtained; after which the springs had been coiled and again tested, and the results compared with theory. The proper arrangement of springs, when several are used together, was discussed, and certain proportions shown to be necessary for springs arranged concentrically. Detail drawings of springs for classes V and X were shown. Experiment has proved the principles to be correct on which these have been designed. Altogether, the paper is valuable as the commencement of an investigation, which, pushed to completion, will render the designing of all kinds of helical springs an exact science. In the discussion it appeared that springs of peculiar shape found their way into the scrap pile; that the introduction of peculiar designs under freight-cars often resulted in an enormous percentage of breakage; that orders to manufacturers are often arbitrary, and contrary to sound principles; that logs are loaded on cars by dropping them from a height of ten feet; and that springs are tested by pounding them together with a steam-hammer, after which they are expected to stand ordinary wear.

The greatest scientific interest, however, attached to the paper of Prof. W. A. Rogers of Cambridge, on a practical solution of the perfect-screw problem. Professor Rogers prefaced the reading by remarking that he considered the American society of mechanical engineers the most appropriate body to receive his first public announcement of success,—a courtesy appreciated by the society. Mechanism of precision was defined as perfect "when it meets all the requirements of the purpose for which it is constructed;" and the two screws, which raise the cross-head of an iron-planer, were discussed in this respect. Precision-screws are tested, not only by direct measurement of the pitch, but by examining optically a surface ruled with many thousand lines to the inch by means of the screw. The first catches all accumulated errors, while the 'diffraction grating' tests the regularity of the spacing for short distances. Scales graduated in Europe, and advertised as without sensible error, are shown, under the comparator,

to merit no such claim: indeed, if we except Professor Rowland's, no screw has hitherto been made, capable of producing graduations sufficiently exact. Three half-metre screws were exhibited which could be mounted for microscopical examination: on one of them, over twelve hundred hours had been spent to make it, by usual methods, as perfect as possible; another, made by the new process, had required but twenty-two hours, and yet, while the microscope showed great irregularities in the former, none could be detected in this; the third was a similar screw before its final grinding. Professor Rogers produces a perfect screw by the following process: an ordinary, well-constructed lathe is used; and cuts of various depths are taken on a preliminary screw, for the purpose of tabulating the errors of the leading screw of the lathe as compared with a standard measuring-bar. This being done, a micrometer-screw is used to vary the relation between the leading screw and the cutting-tool. This screw is kept moving automatically, or by hand, so as always to correspond with the tabulated values, which results in producing a screw nearly free from the errors of the leading screw. This screw is then ground with a nut cut in the same way; and, if not sufficiently perfect, it is then put in the place of the leading screw, and another screw cut from it by the same method, whereby any remaining errors are eliminated. A company has been formed for putting perfect screws on the market.

In the animated discussion which followed, President Sweet gave his experience in constructing the Cornell measuring-machine, and claimed that the nut should be made as long as the screw to avoid unequal wear of the latter. Among other opinions, it was claimed that scraping surfaces to a bearing is better than grinding; that tempered steel should be used, and other means devised for maintaining the screws perfect; and J. A. Brashear was referred to as having solved the problem of flat surfaces up to five inches diameter.

Mr. W. E. Kent of New York presented rules for conducting boiler-tests, in which the precautions necessary for determining the actual heating-power of a fuel, or the efficiency of a steam-boiler, were set forth at length. A committee was appointed to report upon a uniform method of making such tests. Mr. W. B. LeVan resumed his advocacy of quick transit in a paper, 'New York to Chicago in seventeen hours,' in which the time required for each of eight divisions was figured out, the average hourly mileage being fifty-five, whereas seventy to eighty miles is a common speed for short distances between Philadelphia and New York. A change in locomotive valve-motions was also recommended. Mr. Charles E. Emery read 'Estimates for steam-users,' in which he detailed the methods and formulæ in use by his company for arriving at the amount of steam furnished to various classes of customers. The New-York steam company has been selling steam at a fixed price since February, 1883.

Mr. H. R. Towne, of the Yale & Towne company, explained their drawing-office system, by which all

the operations of planning, making, lettering, dimensioning, altering, blue-printing, indexing, and preserving drawings, are reduced to a systematic procedure.

The remaining papers, for which, however, but little time remained, were: 'Cross-sectioning with the right-line pen,' J. B. Webb; 'Comparison of three modern types of indicators,' G. H. Barrus; 'A positive speed-indicator,' O. Smith; 'The experimental steel-works at Wyandotte,' W. F. Durfee; 'Early history of the steel-works at Troy,' R. W. Hunt; 'Experiments on non-conducting coverings for steam-pipes,' J. M. Ordway and C. J. H. Woodbury.

Professor Webb's paper referred to methods in use in his drawing-classes, with specimen of work.

Mr. Barrus gave the weights of the parts of the indicators, but neglected their moments of inertia: he compared the general appearance of the diagrams, and the correctness of the parallel motions: the errors of the springs were given, and the action of the drum mechanism discussed by means of an apparatus for detecting changes of phase. Some of these experiments seem to be in the right direction, but no discussion of underlying mechanical principles was attempted. Mr. Smith's machine is a counter for revolving shafts, *with a clock* which throws it in gear for one minute. The other papers will be read and discussed at the annual November meeting in New-York City.

Thursday was devoted to an excursion, by rail, up the Alleghany River for the purpose of visiting various works and furnaces. Among these were the Spang steel and iron company's works, the Isabella furnaces, the National soda-works, and the Plate-glass works, using natural gas as a fuel. A subscription dinner on Thursday evening, and a water excursion up the Monongahela on Friday, completed the programme of this meeting of the society.

DEVELOPMENT OF THE THYROID AND THYMUS GLANDS AND THE TONGUE.

UNDER the wide title of 'Ueber die derivate der embryonalen schlundbogen und schlundspalten bei säugethieren' (*Arch. mikr. anat.*, xxii. 271), G. Born discusses the development of these organs as determined by observations on pig embryos. These valuable researches give us, for the first time, an understanding of the morphology of the two glands of the above title, which have been a long-standing puzzle to comparative anatomists.

The tongue arises from the anterior part of the ventral floor of the pharynx. The space between the ventral ends of the first and second visceral arches is at first depressed; but later a longitudinal ridge grows up, separated on each side, by a groove, from the arches. The anterior portion of this ridge grows out, and becomes the free part of the tongue: the posterior part of the ridge projects between the third and fourth arches, and develops into the epiglottis. It will thus be evident that the tongue does not extend back beyond the second arch. After the embryo (pig) reaches a length of fifteen millimetres, the

tongue grows rapidly forward. (Although it has long been known that the tongue arises from the floor of the pharynx, the evident conclusion has not been sufficiently recognized, that the epithelial covering of the tongue is entodermal, and not ectodermal, and therefore not the same as the lining of the mouth, as a continuation of which the lingual epithelium is customarily described.)

The fate of the visceral clefts has been more fully elucidated than heretofore. The *first* becomes the outer and middle ear and the Eustachian tube, as is well known: the fate of the others has been obscure. According to Born, the *second* entirely disappears, becoming first a closed sac, and finally undergoing complete atrophy; the *third* likewise becomes a closed sac, which remains some time connected with the epidermis; from the inner end of the cleft arises a short caecum, extending ventrally inwards and forwards, which is the *anlage* of the thymus, and is retained and enlarged, while the rest of the cleft is atrophied; the *fourth* cleft also remains in part as a closed sac, which later joins in the formation of the thyroid gland.

The thymus was first shown by Kölliker (*Entwicklungsgeschichte*, 2te aufl.) to be an epithelial organ, and probably derived from a gill-cleft. Born traces its origin from the third cleft, as a ventral evagination near the inner opening. The caecum grows, at first, without altering its position or general appearance; but the rest of the cleft is reduced to a small canal, the outer part, indeed, to a solid cord of cells (embryo pigs of about sixteen millimetres). The whole, except the thymus portion, is atrophied, but the outer cords persist for a time. The thymus *anlage* spreads out into a canal, with walls of fine, many-layered epithelium. The lower end of the canal rests against the pericardium, where the aorta makes its exit. In embryos of two centimetres, the lumen of the canal has disappeared, and from the solid cord many branches have grown out, most abundantly at the heart end.

The thyroid gland, as was first shown by W. Müller (*Jenaische zeitschr.*, vi. 428, 1871), has a double origin. Born shows that the principal division arises as a median invagination in the floor of the pharynx, on a line with the front edge of the second visceral cleft. Very early this invagination separates from the pharyngeal epithelium, expands laterally chiefly, changes to a network, and at the same time moves backward until it comes to lie behind the glottis. Until the embryo is two centimetres long, the thyroid mass lies near the origin of the third aortic arch (common carotid); but in older embryos the division of the carotids has moved back, away from the head and the thyroid gland. The secondary portion of the thyroid is derived from the paired remnants of the fourth clefts. The median portion of the thyroid early changes into a network of epithelial cords. The outer cells of the cords are cylindrical: the inner cells, in several layers, are not very distinct from one another. Around the cords, the mesoderm forms sheaths of spindle cells, while between them the blood-vessels appear. The lateral *anlagen* become